L3 – Internetworking Devices

by

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EA C451 Internetworking Technologies

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Required Readings

Chapter 15: Connecting LANs, Backbone Networks, and Virtual LANs, Data Communications and Networking, 4th Edition, Behrouz Forouzan.

Sec 4.3: What's Inside a Router?, [Kurose]

Sec 5.6: Link Layer Switches, [Kurose]

Overview reading only

Optional Readings

Wikipedia article on Networking Hardware

Interconnections: Bridges, Routers, Switches, and Internetworking Protocols, 2nd Edition, Radia Perlman.

Chapter 3: Choosing the correct cabling, Cabling: The Complete Guide to Network Wiring, 3rd Edition, David Barnett, David Groth, Jim McBee.

Chapter 3: Networking Devices

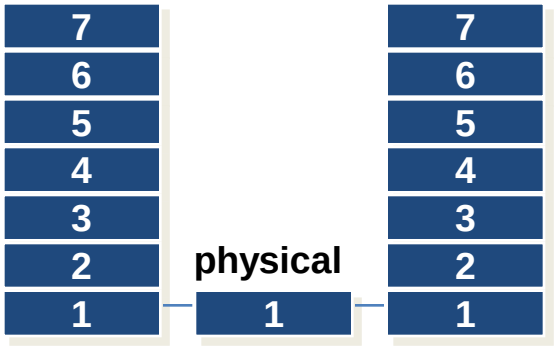
Presentation Overview

Device Gallery

Network Diagrams

Devices

Physical (PHY) Layer



A Few Devices

- Repeater (Amplifier)
- Multiplexer
- Splitter
- Filter
- Radio Tower
- Transceivers

PHY Layer Symbols

Ethernet Line

Wireless Link

Optical Amplifier

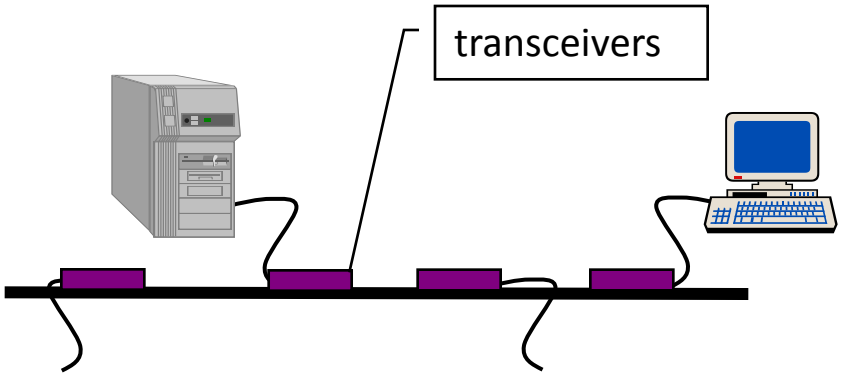
Repeater

DSLAM – DSL Access Multiplexer

DWDM (Optical) Filter

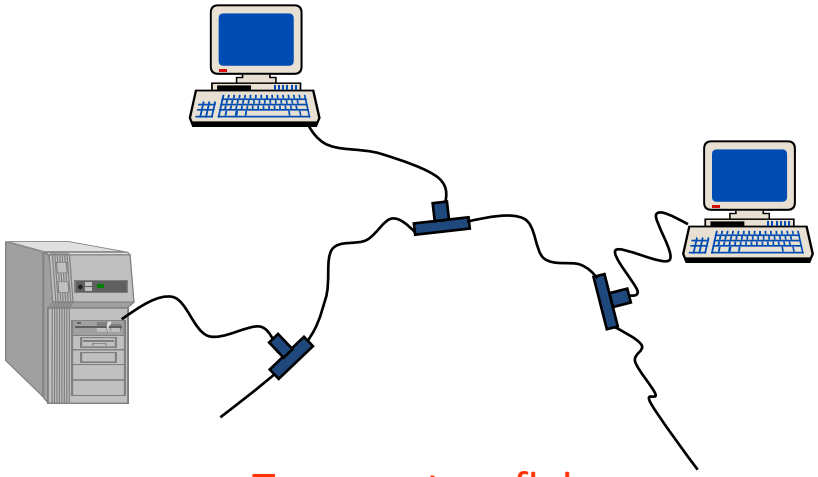
Radio tower

Physical (PHY) Layer Examples



Thick Coax: Stiff, hard to work with

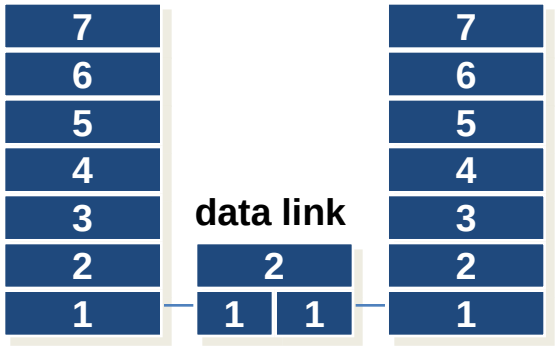
Transceivers



T connectors flaky

Splitters

Datalink Layer (DLL)



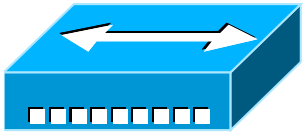
A Few Devices

- Modems
- Hubs
- Brides
- Wireless Access Points
- Switches

Datalink Layer (DLL) Symbols

Modem

Access Point



Hub

Hub

100BaseT Hub

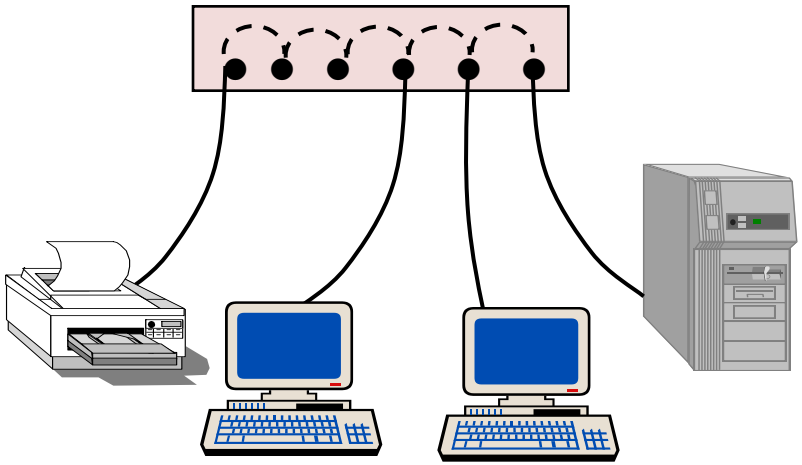
Bridge

Wireless Bridge

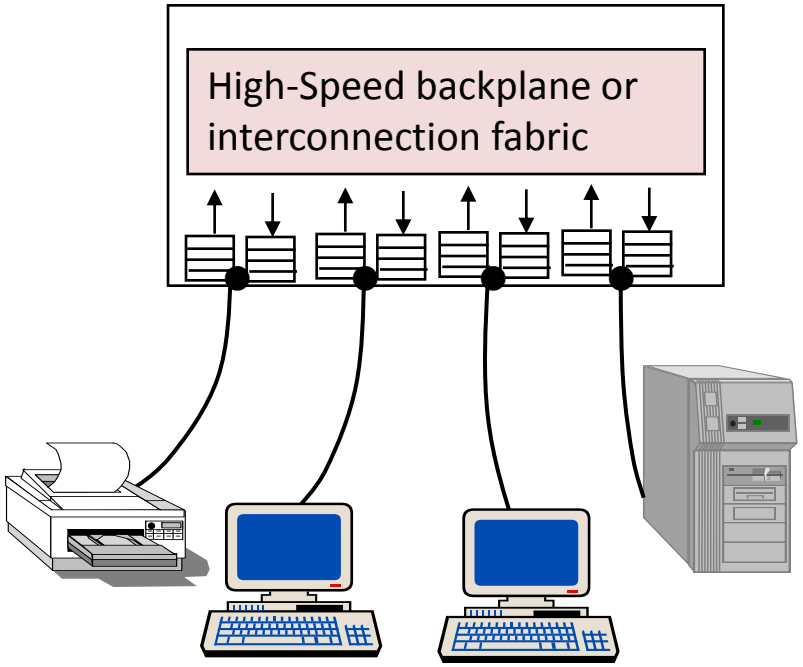
Switch

ATM Switch

Datalink Layer (DLL) Examples

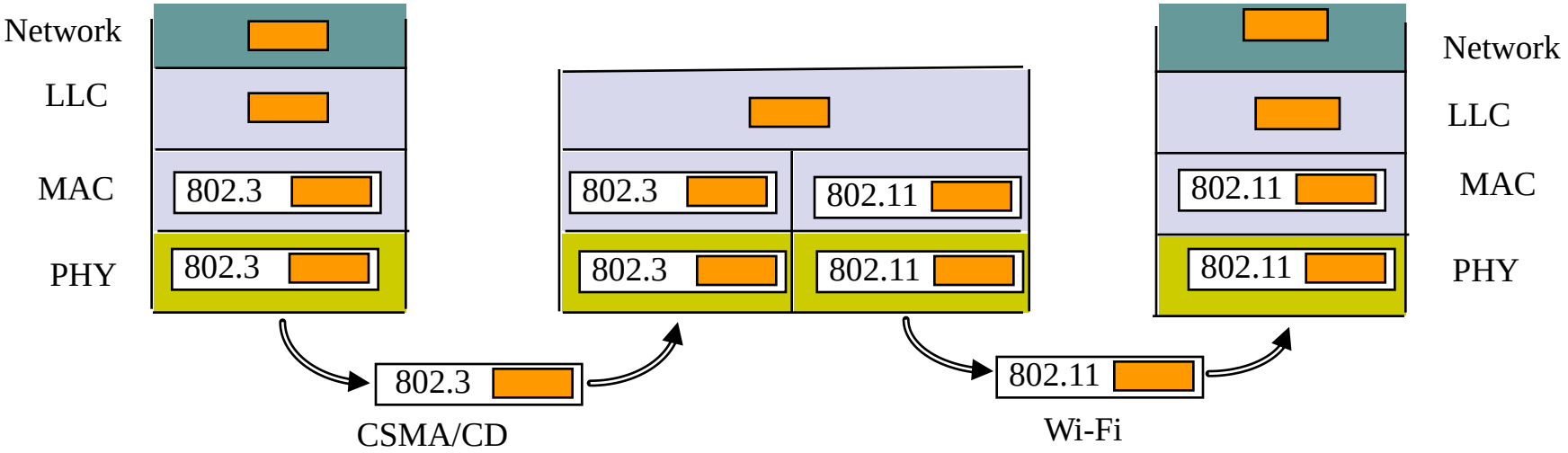


Hubs



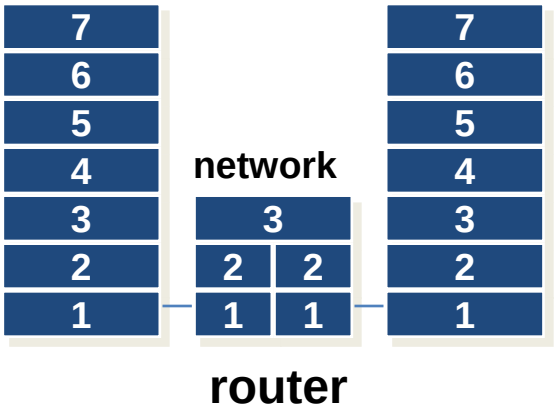
Bridges / Switches

General Bridge Example



Operation at data link level implies capability to work with multiple link-layer technologies

Network Layer



A Few Devices

- Routers
- Network Address Translators - NAT (Layers 3 and 4)
- Firewalls (Layers 3 to 7)

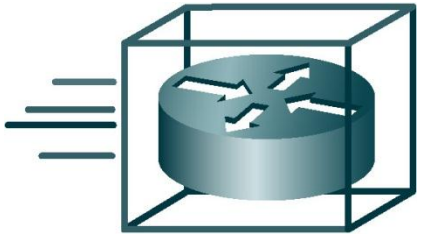
Network Layer Symbols

Router

Wavelength Router

ATM Router

Wireless Router

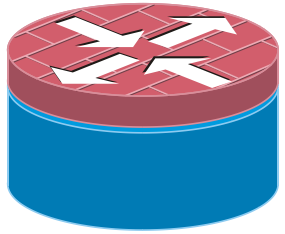


Mobile Router

NAT

Network Cloud

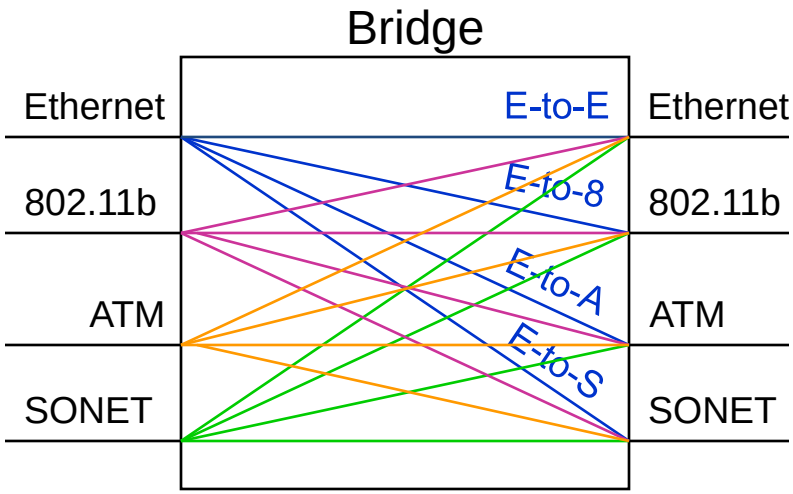
Firewall



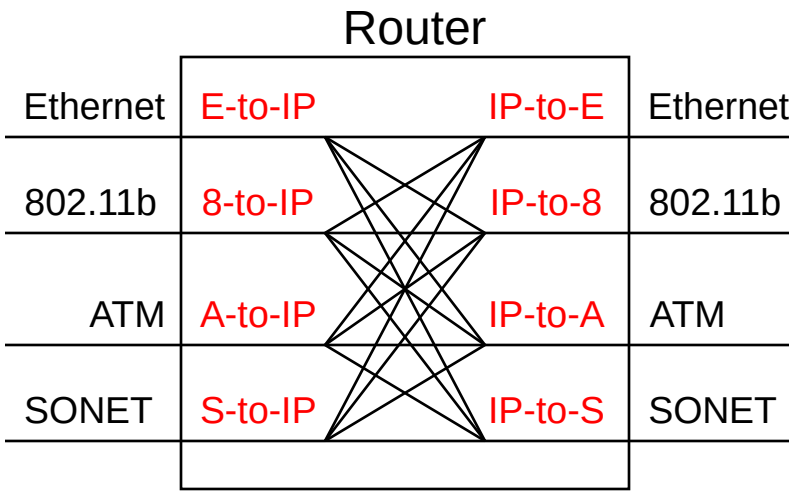
Router with Firewall

Bridge vs Router

- Router interconnects different link layer protocols more easily at the cost of additional processing



$O(n^2)$ converters
n = different link types



O(n) converters

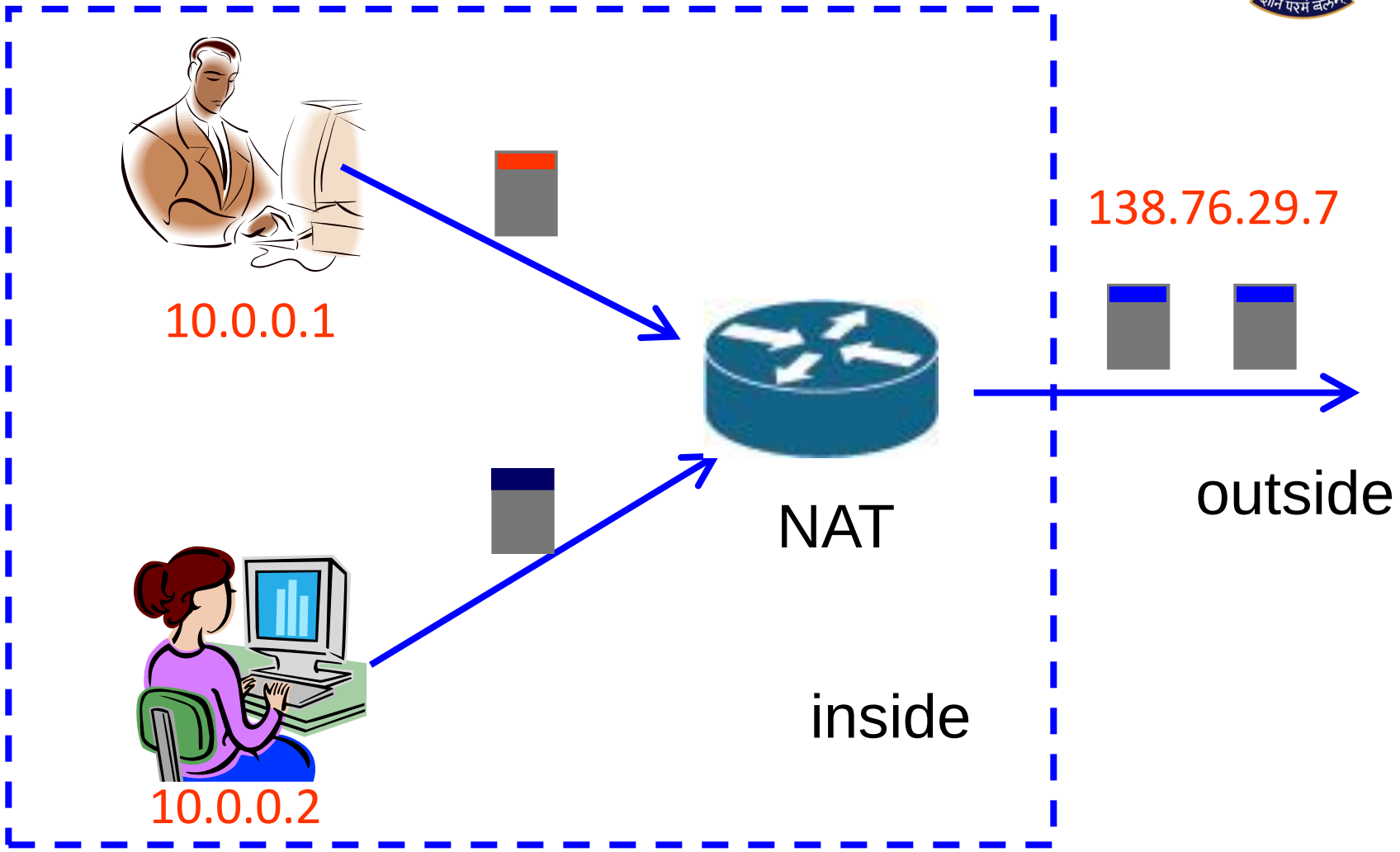
Comparing Hubs, Switches, Routers

	Hub/ Repeater	Bridge/ Switch	Router
Traffic isolation	no	yes	yes
Plug and Play	yes	yes	no
Efficient routing	no	no	yes
Cut through	yes	yes	no

Middleboxes

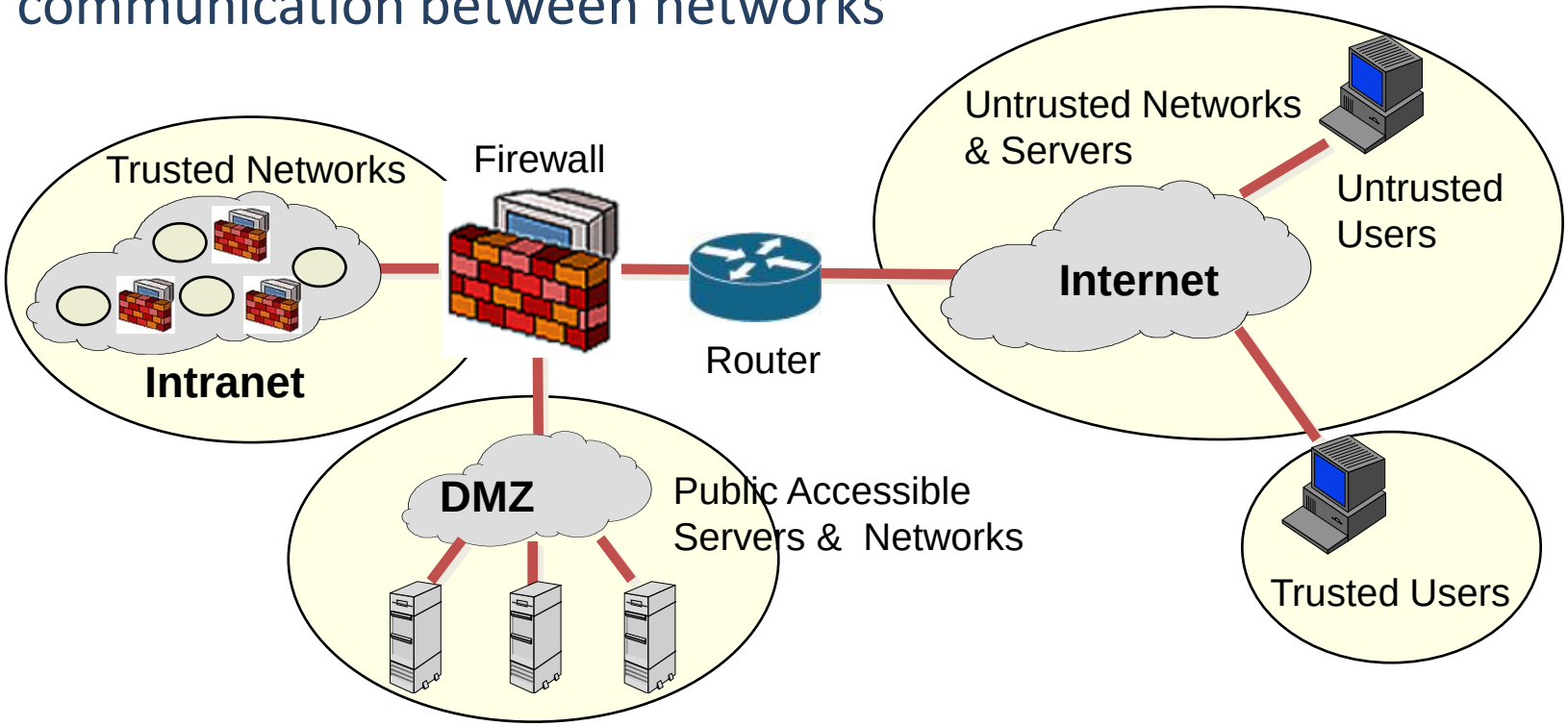
- Middleboxes are intermediaries
  - Interposed in-between the communicating hosts
  - Often without knowledge of one or both parties
- Examples
  - Network address translators (NAT)
  - Firewalls
  - Traffic shapers
  - Intrusion detection systems
  - Transparent Web proxy caches
  - Application accelerators

Router with Integrated NAT

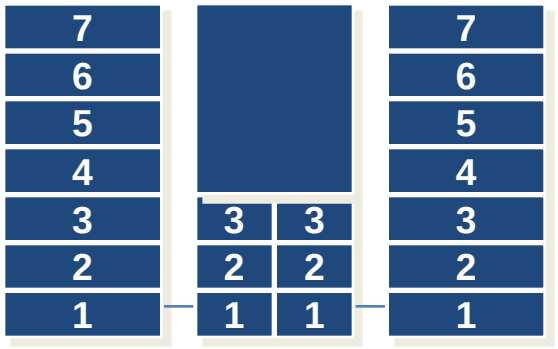


Firewall

- Device that provides secure connectivity between networks (internal/external; varying levels of trust)
- Used to implement and enforce a security policy for communication between networks

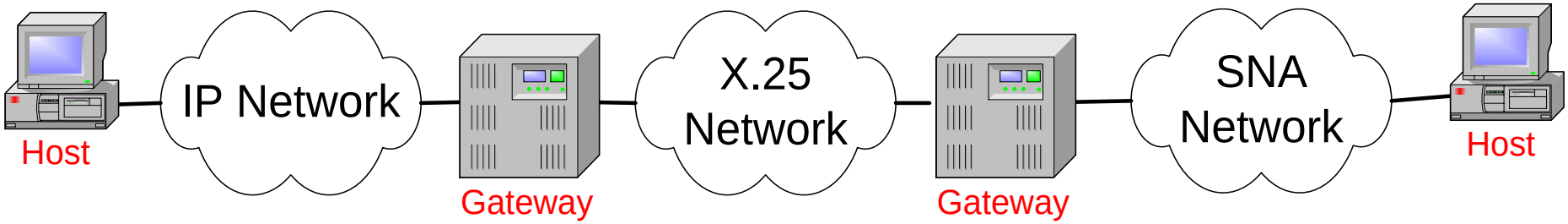


Higher Layers - Gateways



A Few Devices

- Protocol translators
- Proxy Server (Layer 7)



In the past, even routers were called gateways

Symbols of Gateways

Protocol Translator (Gateway)

Class 4-5 Switch

Content Cache

Content Service Router

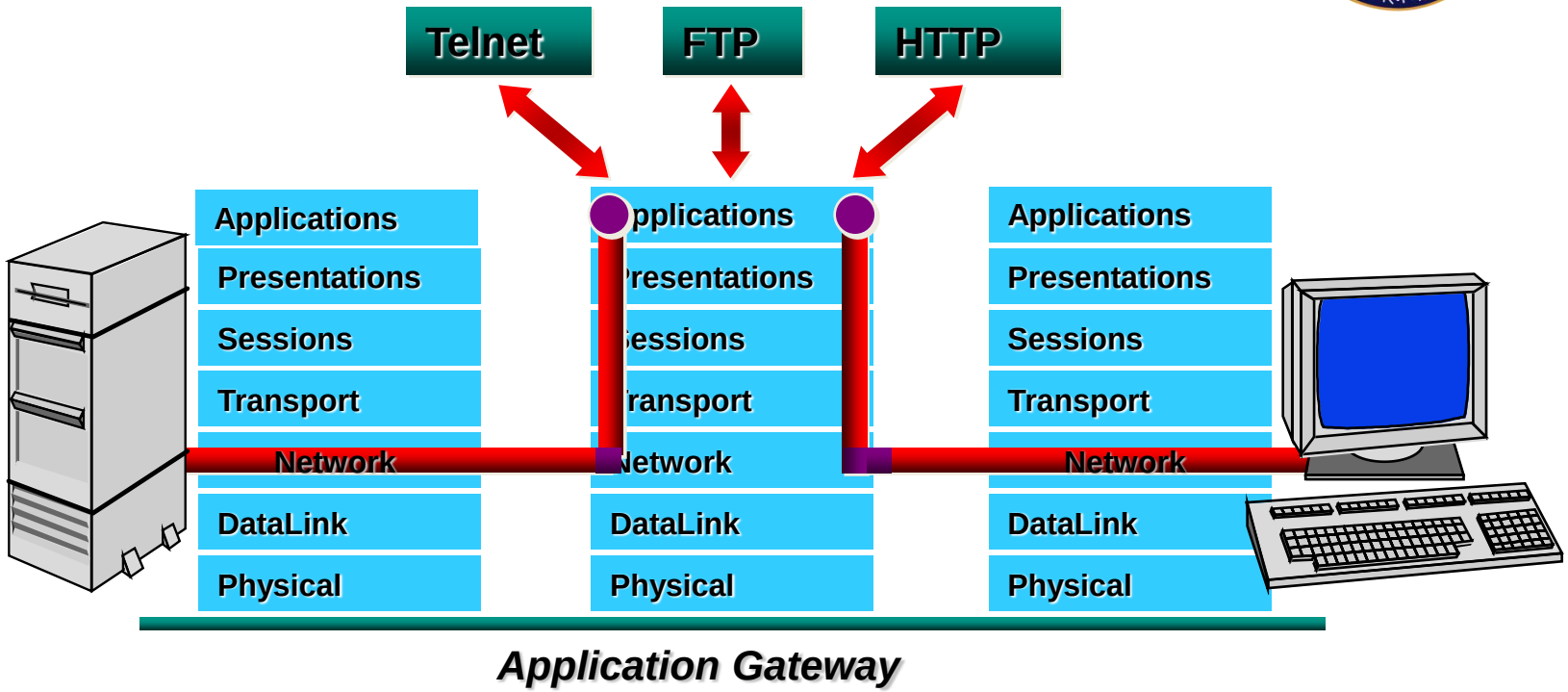
Hosts (End Nodes)

Workstation

Server

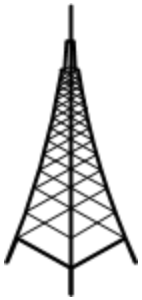
Tablet

Application Layer GW/Proxy



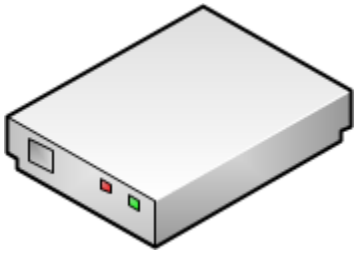
The network stack on the two end nodes may be different

Microsoft Networking Symbols

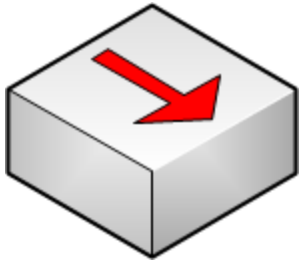


Antenna

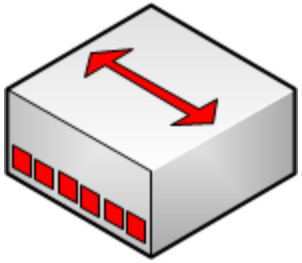
Repeater



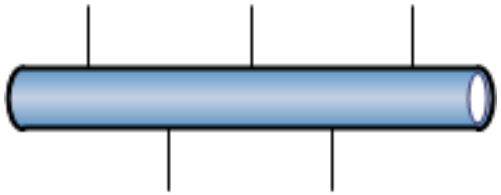
Modem



100BaseT Hub

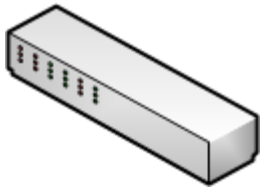


Hub

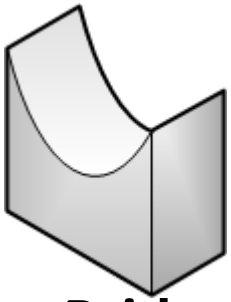


Ethernet Network

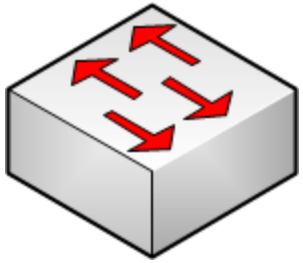
Wireless AP



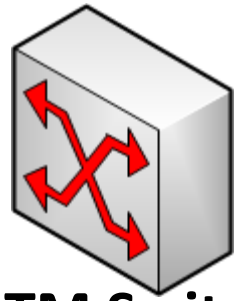
Switch



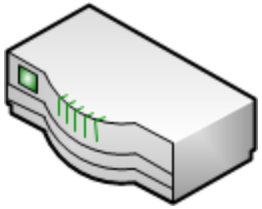
Bridge



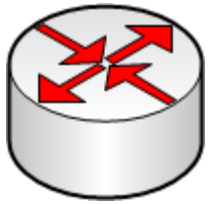
Switch



ATM Switch



Router



Router

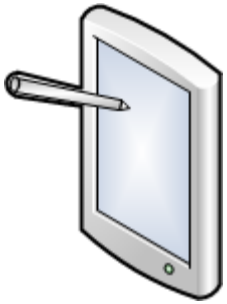
Microsoft Networking Symbols

Gateway

Server

PC

Laptop



Tablet

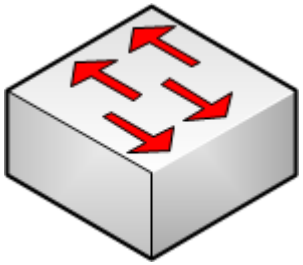
Summary of Symbols

Switch

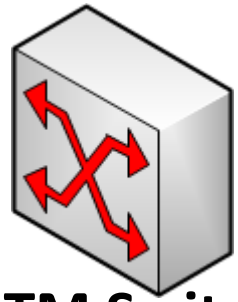
ATM Switch

Network Cloud

Server



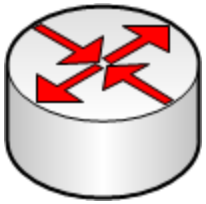
Switch



ATM Switch

Firewall

Router



Router

PC

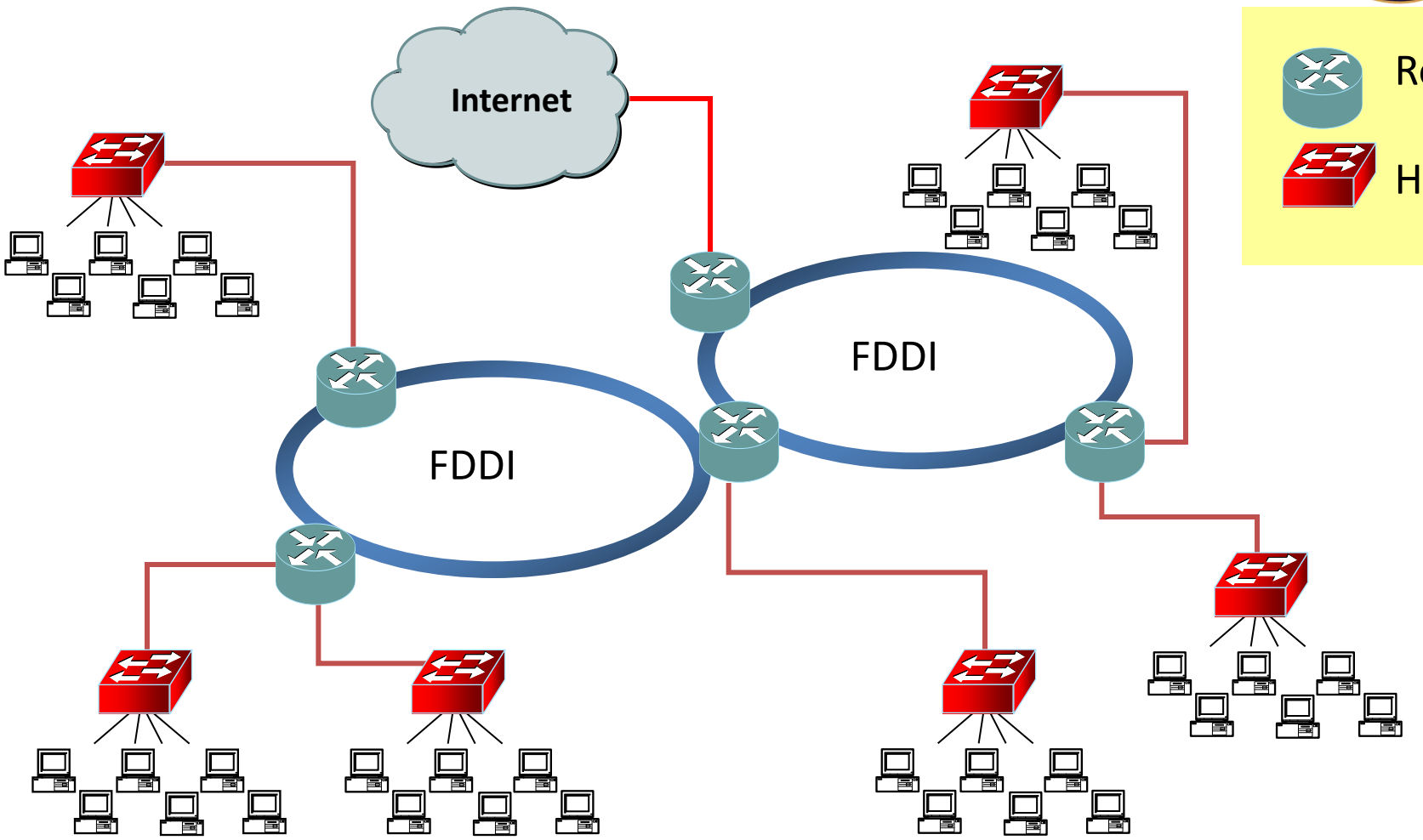
Presentation Overview

Device Gallery

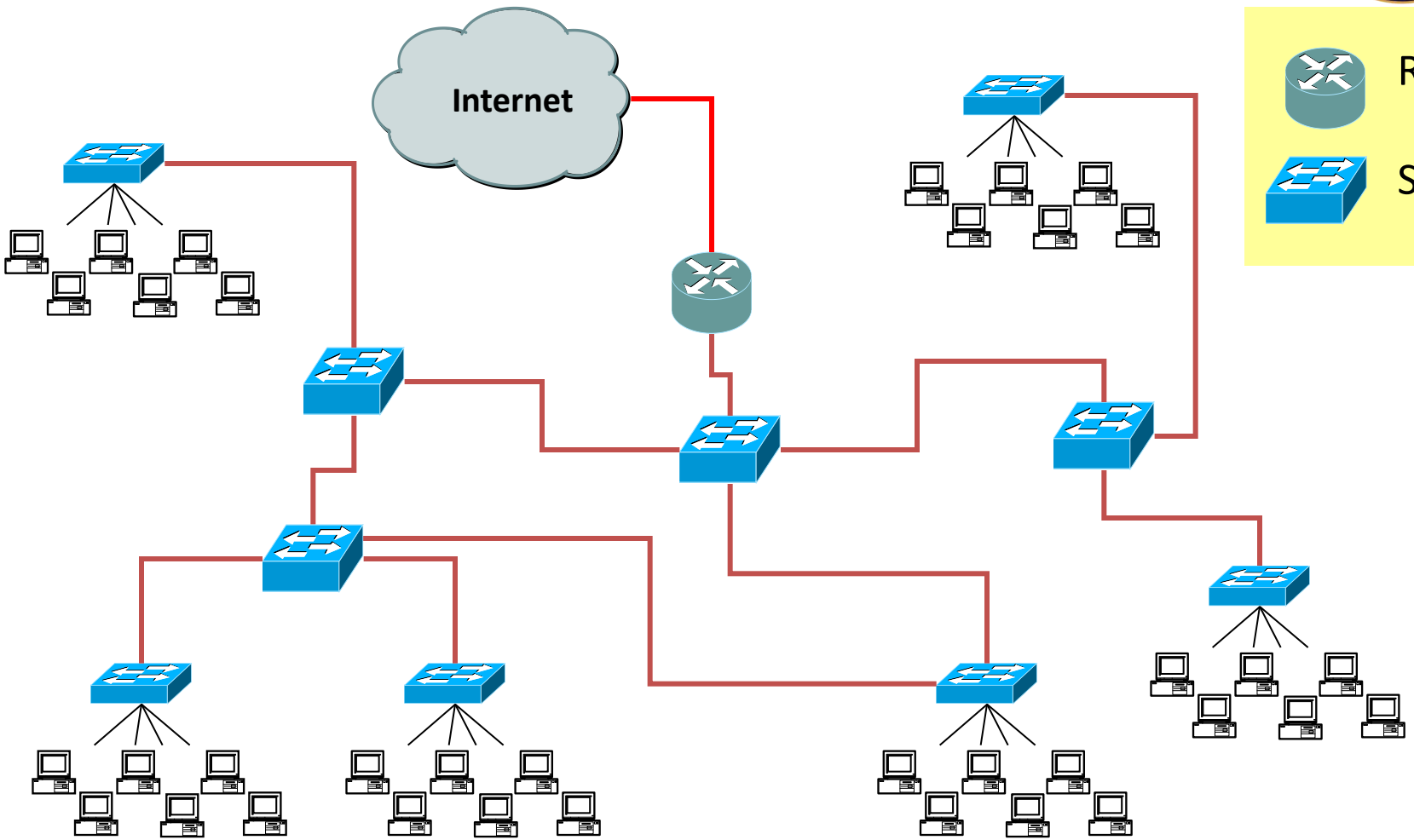
Network Diagrams

Devices

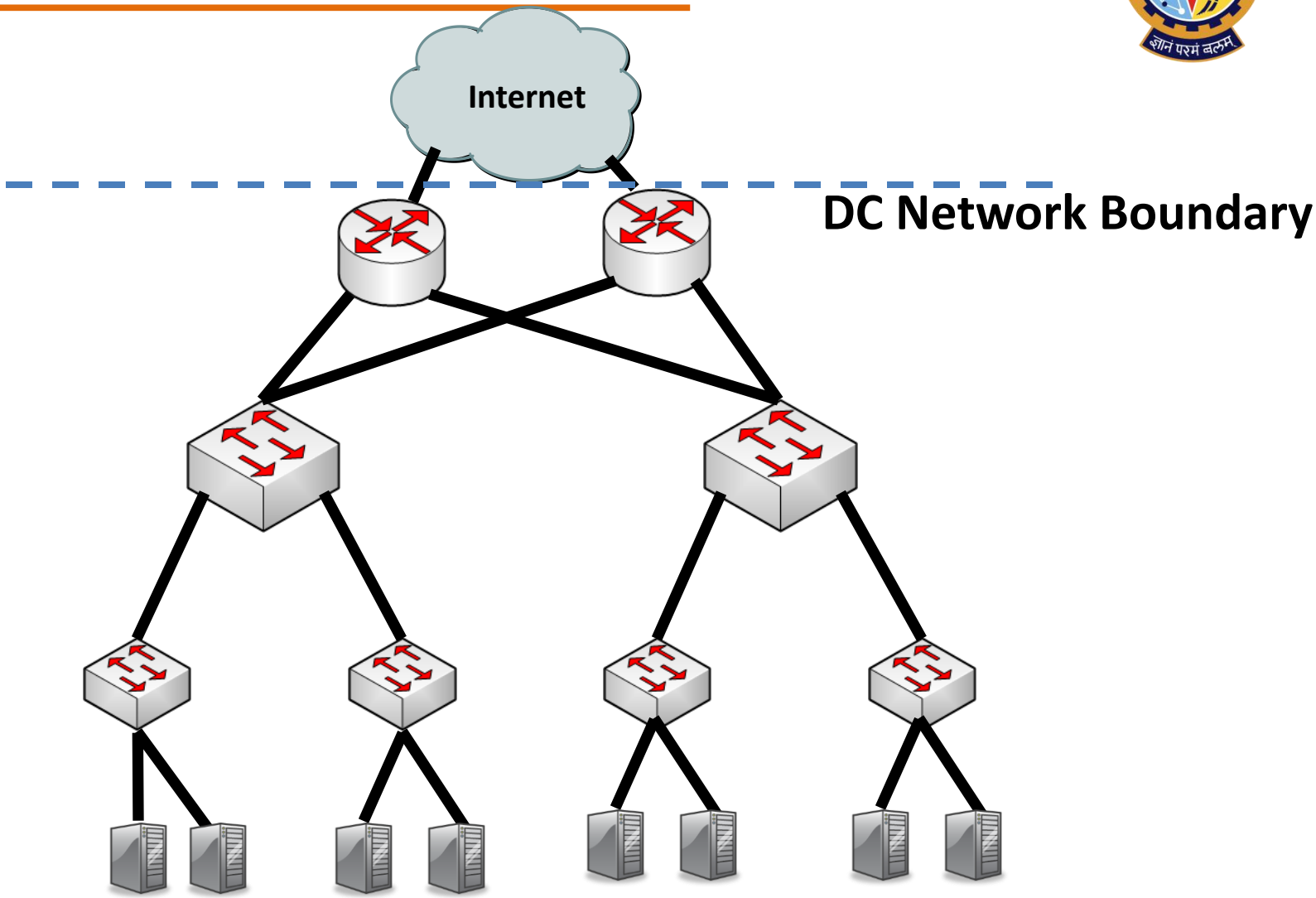
A Routed Enterprise Network



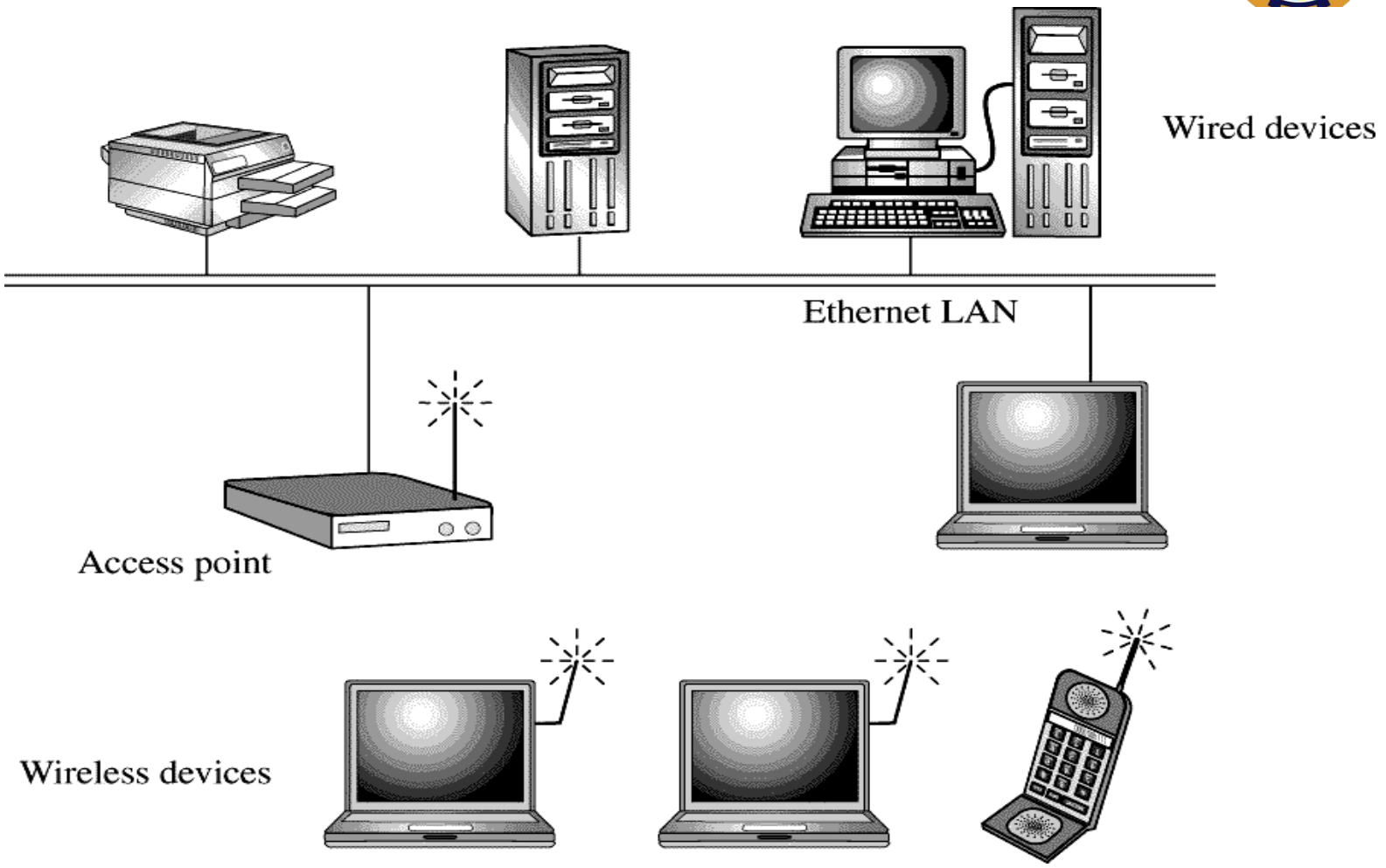
A Switched Enterprise Network



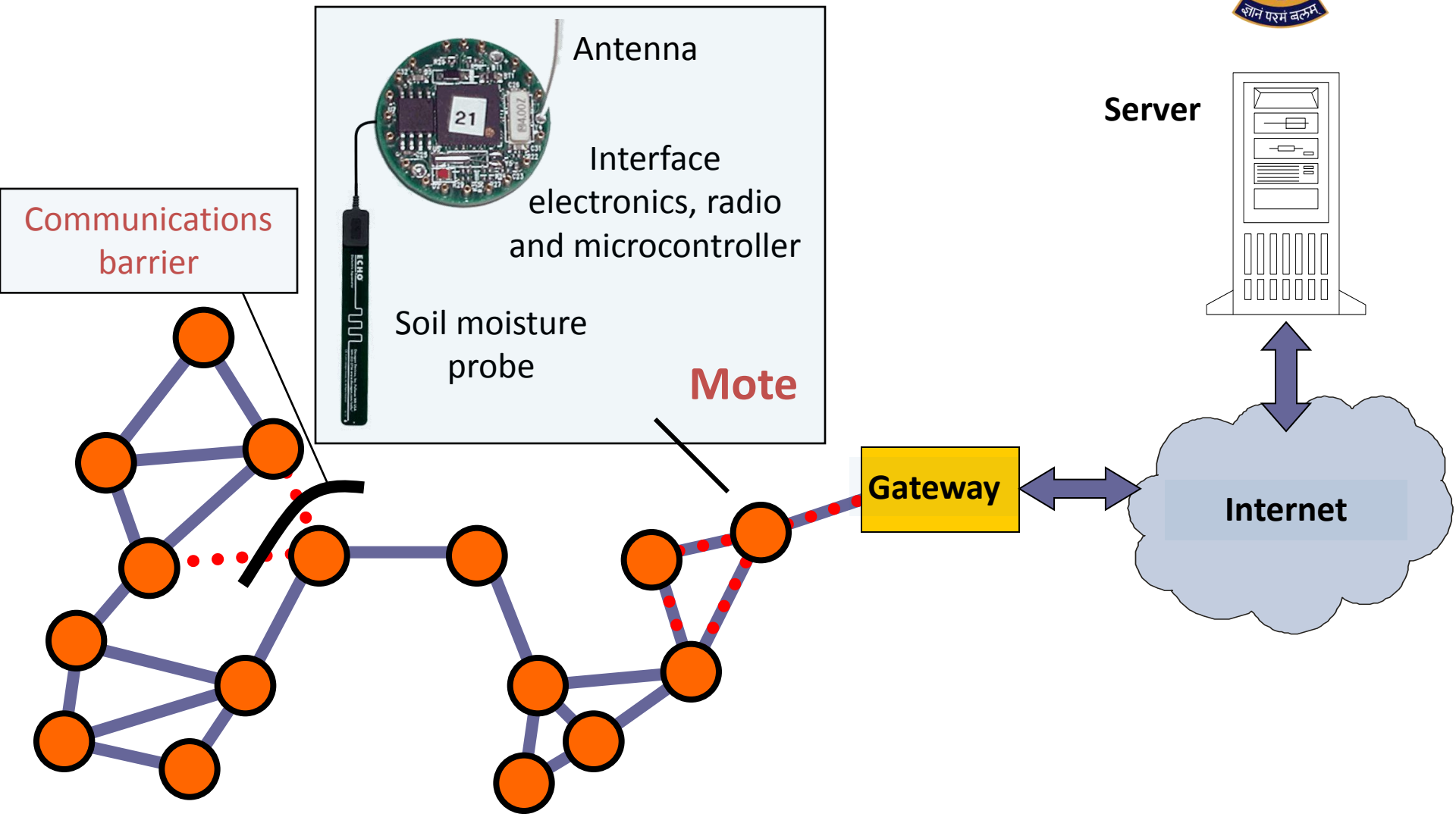
Datacenter Network



Wireless LAN



Sensor Networks



Presentation Overview

Device Gallery

Network Diagrams

Devices

Wired Network Components

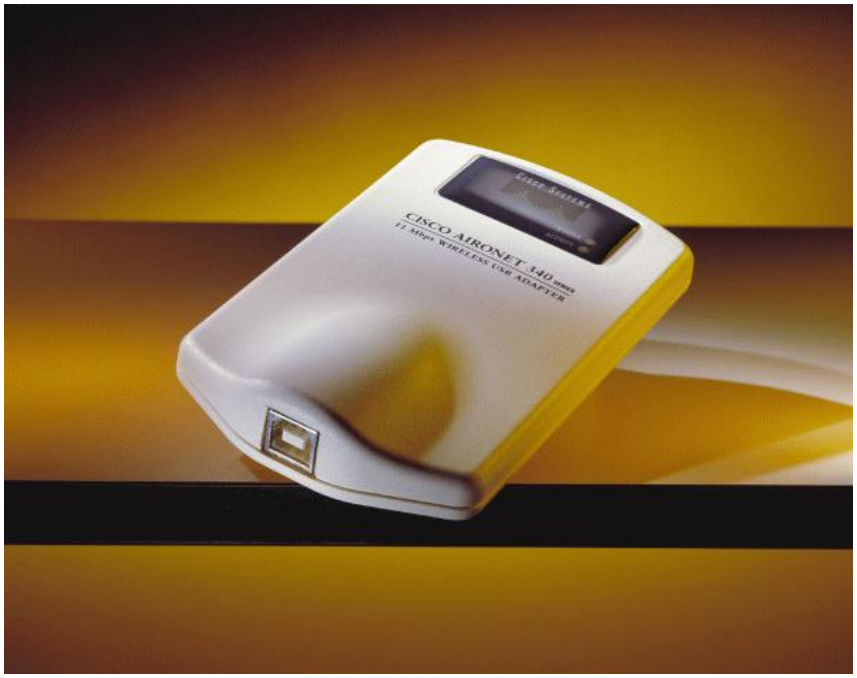
Network Interface Card (NIC)

Switch

Wireless Network Components

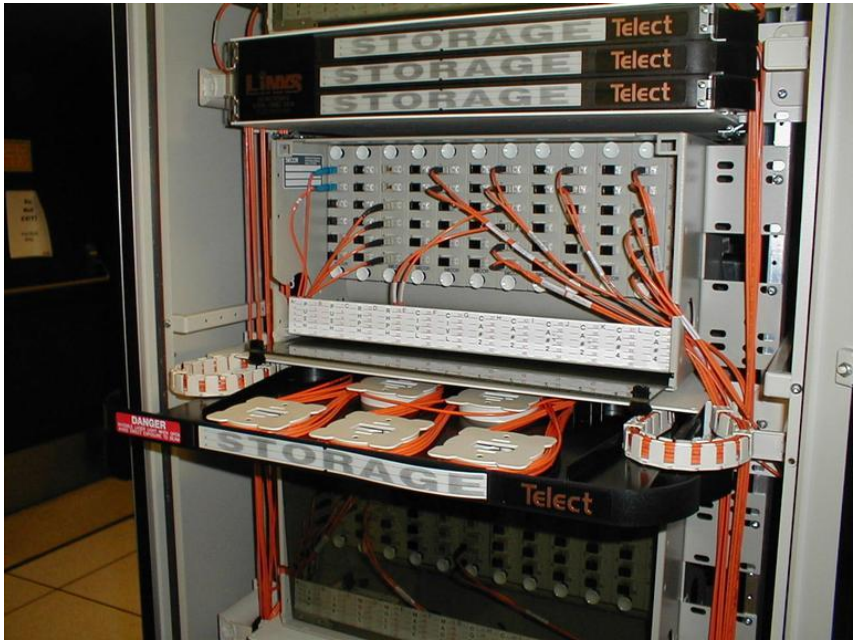
Wireless Cards & Gateway

Wireless LAN Interface



Networking Rack

Patch Panel Front



Patch Panel Back

Modern Routers

Cisco 12016: 80 Gbps
Cisco 12416: 320 Gbps
Cisco 12816: 1280 Gbps
Power: 4.2 KW

Juniper M 320

320 Gbps

Power 3.2 KW

Miscellaneous

IP Phone